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TECHNICAL MEMORANDUM 1133

GROWTH
OF
COMPOSITION B TYPE CHARGES

ROBERT T. SCHIMMEL
STANLEY J. LOWELL

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MARCH 1963

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PICATINNY ARSENAL
DOVER, NEW JERSEY

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AMMUNITION GROUP

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BY

ROBERT T. SCHIMMEL
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AMCMS 5520.21.43401

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PICATINNY ARSENAL
DOVER, NEW JERSEY

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OBJECT

To determine an effective method of controlling the growth of Composition B type charges.

SUMMARY

The growth of Composition B-type charges was investigated because of its potential safety hazard during firing. The explosives tested were Composition B, Composition B/calcium silicate (99.5/0.5), Composition B4 and TNT. These explosives were either standard or vacuum melted and cast in XM83 Bursters. The interior of the burster tube was coated with either acid-proof black paint or MIL-P-22332 primer paint. Then these charges were subjected to 160° F for 15 days.

The maximum growth (0.430 inch) was observed with Composition B when standard melted and cast into acid-proof black paint coated-burster tubes. The addition of calcium silicate, vacuum melting the explosive and changing the interior coating to MIL-P-22332 primer paint reduced the growth considerably but did not eliminate it. The tests showed that Composition B4, when cast into MIL-P-22332 primer paint coated burster tubes, yielded the least growth (0.070 inch). Explosive growth cannot be entirely eliminated. However, by loading below the top of the tube, the growth can be tolerated.

CONCLUSIONS

1. Of the compositions tested, least growth is obtained with Composition B4 surrounded by an interior coating of MIL-P-22332 primer paint. Vacuum melting is immaterial.
2. The growth of Composition B/calcium silicate is reduced by vacuum melting when cast into burster tubes coated with acid-proof black paint.
3. Composition B4, surrounded by the interior coating MIL-P-22332 primer paint, grows less than any of the systems tested with Composition B/calcium silicate (99 5/0.5).

RECOMMENDATIONS

1. Composition B4 should replace Composition B and should be used with MIL-P-22332 primer paint as the interior coating in ammunition rather than acid-proof black paint.
2. When casting Composition B4 into burster tubes, allow for 0.1 inch growth of the charge.

INTRODUCTION

1. During March 1961 20 Composition B-loaded XM83 Bursters were subjected to 160° F storage at Dugway Proving Ground, Utah. After a few days the bursters were examined and, although there was no evidence of exudation, all of the charges had grown so they protruded from the tubes. After 14 days one of the charges had grown 0.70 inch.
2. A hurried investigation was conducted so the XM71E3 Bursters being loaded for acceptance tests would not be delayed. The results of this preliminary investigation showed that by vacuum melting Composition B4, and pouring it in the burster tube one-fourth inch below the top of the tube, the growth was tolerable. Then a more detailed study was undertaken to determine if the growth problem could be entirely eliminated.

RESULTS

3. Table I shows that a TNT charge 24" long, (the length used throughout) grew 0.178". The addition of 1.25% calcium silicate to TNT reduced the growth to 0.065 inch (63% reduction). Composition B, when standard melted and cast into acid-proof black paint coated burster tubes yielded 0.430 inch growth; with 0.5% calcium silicate added the growth was reduced to 0.351 inch (25% reduction).

4. Composition B/calcium silicate cast into a MIL-P-22332 primer paint coated tube grew 0.244 inch, which is 47% less than the control (Composition B with acid-proof black paint). Changing the type of melt from standard to vacuum reduced the growth to 0.147 inch (65%) when acid-proof black paint was used and 0.222 inch (49%) when MIL-P-22332 primer paint was used.

5. Composition B4 tested with an interior coating of primer paint in one case and acid-proof black paint in another reduces growth to 0.070 inch (87%) and 0.099 inch (78%) respectively. Vacuum melting the explosive in either case does not change the effect.

6. Five acid-proof black paint-coated burster tubes were loaded with Composition B/calcium silicate, four of the tubes were stored in a horizontal position and the other tube was placed vertical (open end up) with a 40-lb. weight on top of it. The latter charge grew 41% less (0.095 inch) than the average horizontal charge (0.162 inch).

7. Figures 1 - 6 illustrate graphically the rate of explosive growth under the various test conditions. The condition that fostered the most growth was Composition B when cast into acid-proof black painted-coated burster tubes using standard melt procedures (0.430 inch).

DISCUSSION OF RESULTS

8. The smallest average growth of charge in all the tests was encountered by using Composition B4 with a surround of MIL-P-22332 primer paint. Vacuum melting the charge prior to loading did not reduce growth. Using acid-proof black paint as a surround significantly increased growth.

9. Under no circumstances could either Composition B or Composition B/calcium silicate be made to approach the extent of growth reduction accomplished very simply, with Composition B4. Since the only difference between Composition B/calcium silicate and Composition B4 is the absence of 1% desensitizing wax in Composition B4, the wax must be a contributing factor in growth. The exact relationship behavior of desensitizing wax in respect to growth is not known, but it is assumed that during high temperature storage (160° F) the wax softens sufficiently or becomes liquid, thus allowing the wax to flow along the path of least resistance, out of the tube.

During this flow it is possible for the wax to either push ahead or carry along small explosive particles. In the overall picture, the phenomenon of TNT crystal growth surely plays some part. The amount it contributes in RDX/TNT compositions must be small since TNT alone grew maximum 0.178 inch while Composition B under the same conditions grew maximum 0.436 inch.

10. The results show that a 40-lb. weight on the explosive charge could not stop growth although it reduced it by 41%. Evidently, there is a considerable force exerted in the growing process, sufficient to distort and perhaps burst a thin metal container.

11. Originally calcium silicate was incorporated into TNT (and TNT containing explosives) to prevent exudation (Ref 1). Table I shows that the incorporation of calcium silicate into TNT and Composition B significantly reduces the amount of growth obtained.

12. In all of the tests conducted only one group showed a significant difference in growth when vacuum melting was used, Composition B/calcium silicate in a surround of acid-proof black paint. The standard melt averaged 0.334 as compared to the vacuum melt 0.116 inch. Although this is a significant reduction it is not as simple a procedure nor as effective as the best Composition B4 system which averaged 0.057" growth under the same test conditions.

13. The growth of explosive charge cannot be completely eliminated, however, it can be tolerated when loaded into burster tubes by facing off the explosive below the top of the tube to allow for the growth of the charge. For Composition B4, an allowance of 1/8" would be ample.

EXPERIMENTAL PROCEDURE

In all of the growth tests conducted, XM83 Burster Tubes (Figure 7) were used rather than the XM71E3 because of their greater length and volume. The tubes were coated with either acid-proof black paint (MIL-P-450B) or priming paint (MIL-P-22332) and loaded with either standard melted or vacuum melted explosives. All of the tests were run for 15 days at 160° F.

REFERENCE

1. R.W. Heinemann, Control of Exudation by Absorbents, Picatinny Arsenal Technical Report 2568, October 1958.

APPENDIX A

TABLE

TABLE I

MAXIMUM GROWTH OF EXPLOSIVE CHARGES AFTER 15 DAYS STORAGE AT 160° F

Explosive	Additive	Type of Melt	Interior Burster Coating	Growth (in.)			Number Samples
				Avg	Max	Min	
TNT	None	Standard	Acid-Proof Black Paint	.094	.178	.048	4
TNT	1.25% Calcium Silicate	Standard	Acid-Proof Black Paint	.046	.066	.030	4
Composition B	None	Standard	Acid-Proof Black Paint	.317	.430	.226	5
Composition B	0.5% Calcium Silicate	Standard	Acid-Proof Black Paint	.186	.351	.097	5
Composition B	0.5% Calcium Silicate	Standard	Acid-Proof Black Paint	.222	.317	.188	5
Composition B	0.5% Calcium Silicate	Standard	MIL-P-22332 Primer Paint*	.108	.244	.049	5
Composition B	0.5% Calcium Silicate	Standard	MIL-P-22332 Primer Paint	.116	.232	.101	5
Composition B	0.5% Calcium Silicate	Standard	MIL-P-22332 Primer Paint	.065	.209	.006	10
Composition B	0.5% Calcium Silicate	Vacuum	Acid-Proof Black Paint	.074	.085	.060	5
Composition B	0.5% Calcium Silicate	Vacuum	Acid-Proof Black Paint	.087	.147	.055	5
Composition B	0.5% Calcium Silicate	Vacuum	MIL-P-22332 Primer Paint	.054	.094	.024	5

TABLE I (Continued)

MAXIMUM GROWTH OF EXPLOSIVE CHARGES AFTER 15 DAYS STORAGE AT 160° F

<u>Explosive</u>	<u>Additive</u>	<u>Type of Melt</u>	<u>Interior Bursting Coating</u>	<u>Growth (in.)</u>			<u>Number Samples</u>
				<u>Avg</u>	<u>Max</u>	<u>Min</u>	
Composition B	0.5% Calcium Silicate	Vacuum	MIL-P-22332 Primer Paint	.151	.222	.142	5
Composition B	0.5% Calcium Silicate	Vacuum	MIL-P-22332 Primer Paint	.054	.118	.005	10
Composition B	None	Standard	Unpainted	.174	.226	.142	10
Composition B4	None	Standard	Acid-Proof Black Paint	.079	.099	.046	6
Composition B4	None	Standard	Acid-Proof Black Paint	.068	.086	.028	5
Composition B4	None	Standard	Acid-Proof Black Paint	.085	.093	.067	5
Composition B4	None	Standard	MIL-P-22332 Primer Paint	.046	.070	.016	5
Composition B4	None	Standard	MIL-P-22332 Primer Paint	.050	.067	.027	5
Composition B4	None	Standard	MIL-P-22332 Primer Paint	.014	.034	.003	10
Composition B4	None	Vacuum	Acid-Proof Black Paint	.046	.102	.027	10
Composition B4	None	Vacuum	Acid-Proof Black Paint	.074	.083	.030	5

TABLE I (Continued)
MAXIMUM GROWTH OF EXPLOSIVE CHARGES AFTER 15 DAYS STORAGE AT 160° F

<u>Explosive</u>	<u>Additive</u>	<u>Type of Melt</u>	<u>Interior Burster Coating</u>	<u>Growth (in.)</u>			<u>Number of Samples</u>
				<u>Avg</u>	<u>Max</u>	<u>Min</u>	
Composition B4	None	Vacuum	Acid-Proof Black Paint	.056	.083	.019	5
Composition B4	None	Vacuum	MIL-P-22332 Primer Paint	.057	.073	.049	5
Composition B4	None	Vacuum	MIL-P-22332 Primer Paint	.013	.031	.001	5
Composition B4	None	Vacuum	MIL-P-22332 Primer Paint	.032	.055	.010	10

* Code H4929 Primer Paint

APPENDIX B

FIGURES

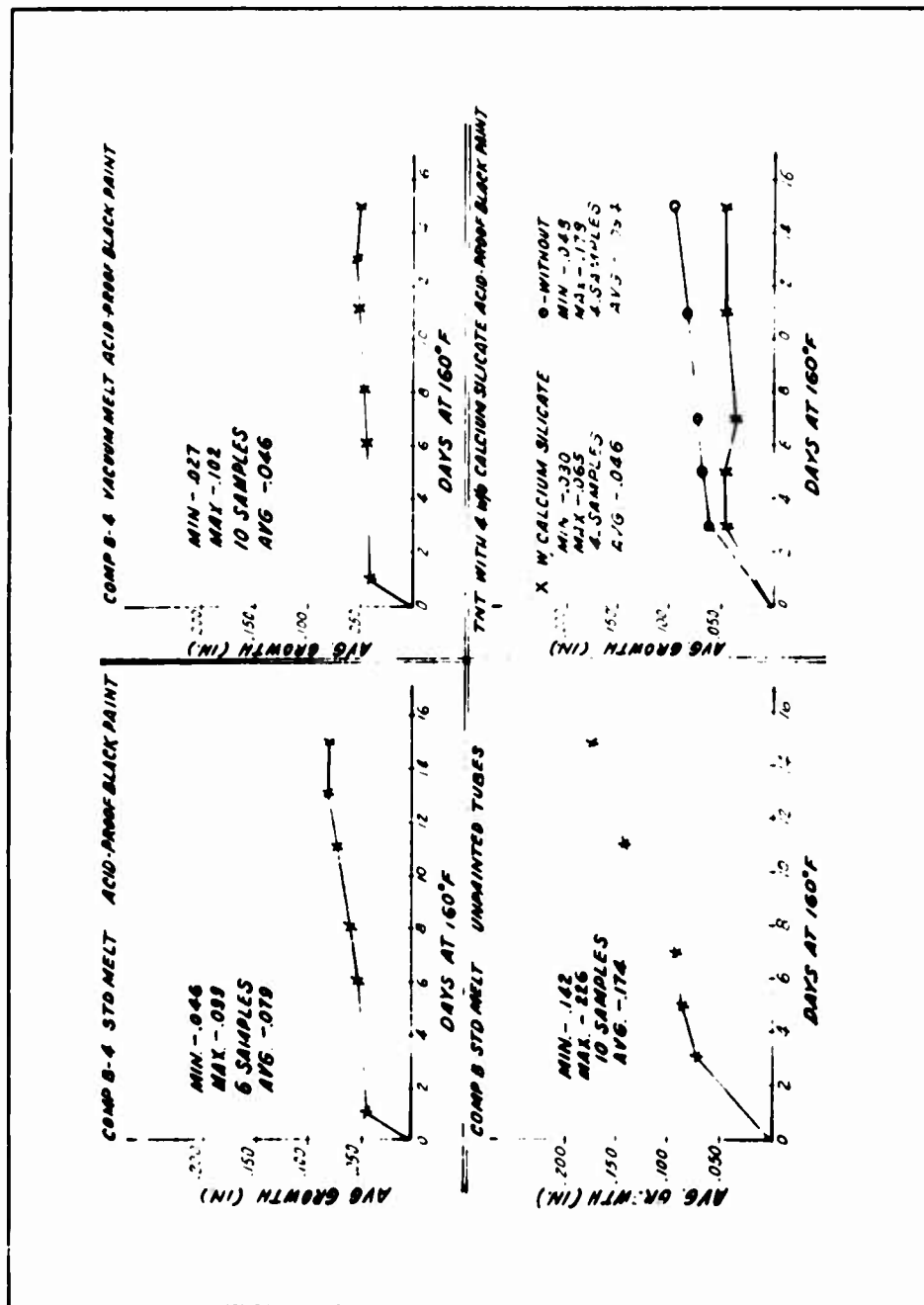


Figure 1.

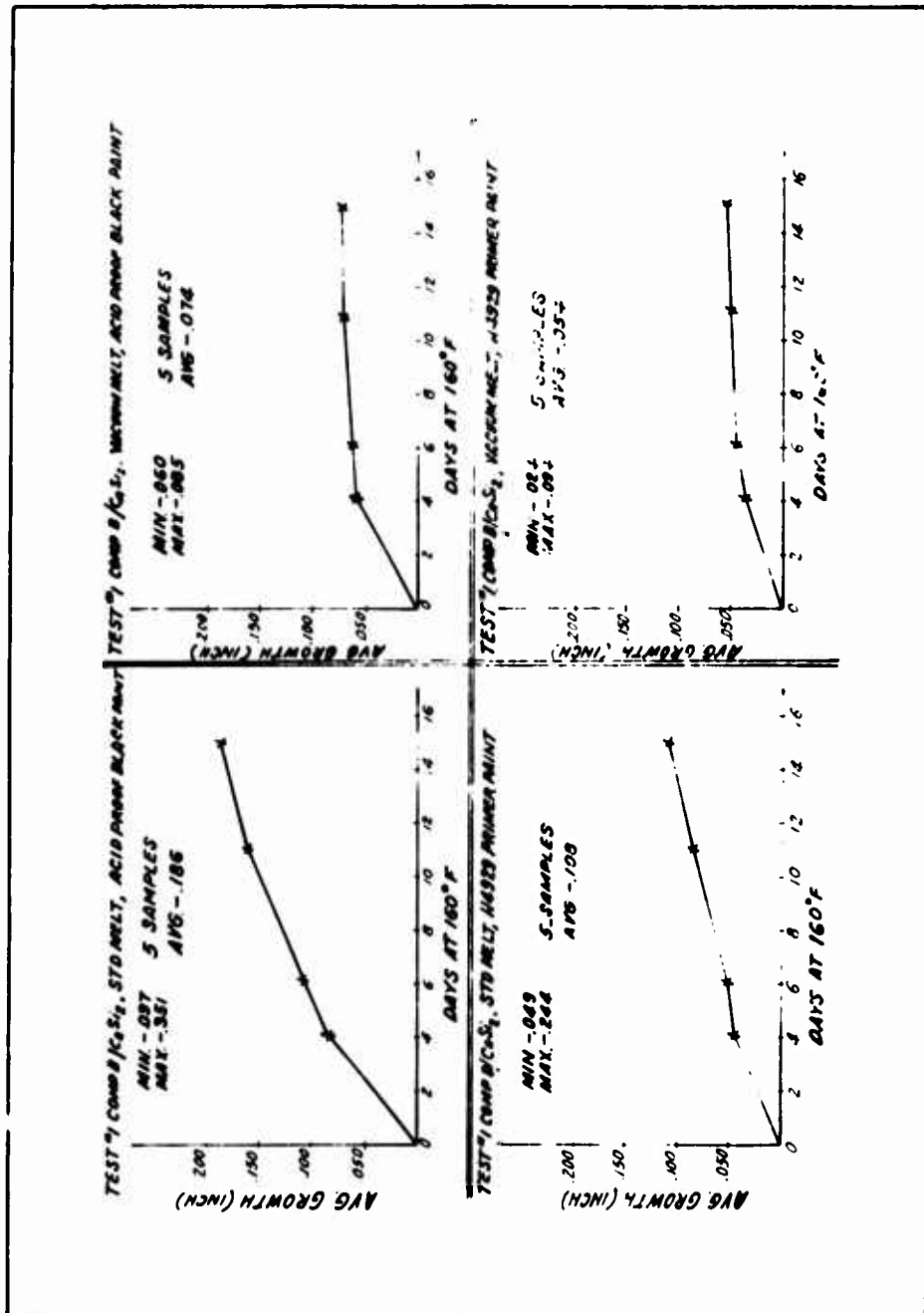


Figure 2.

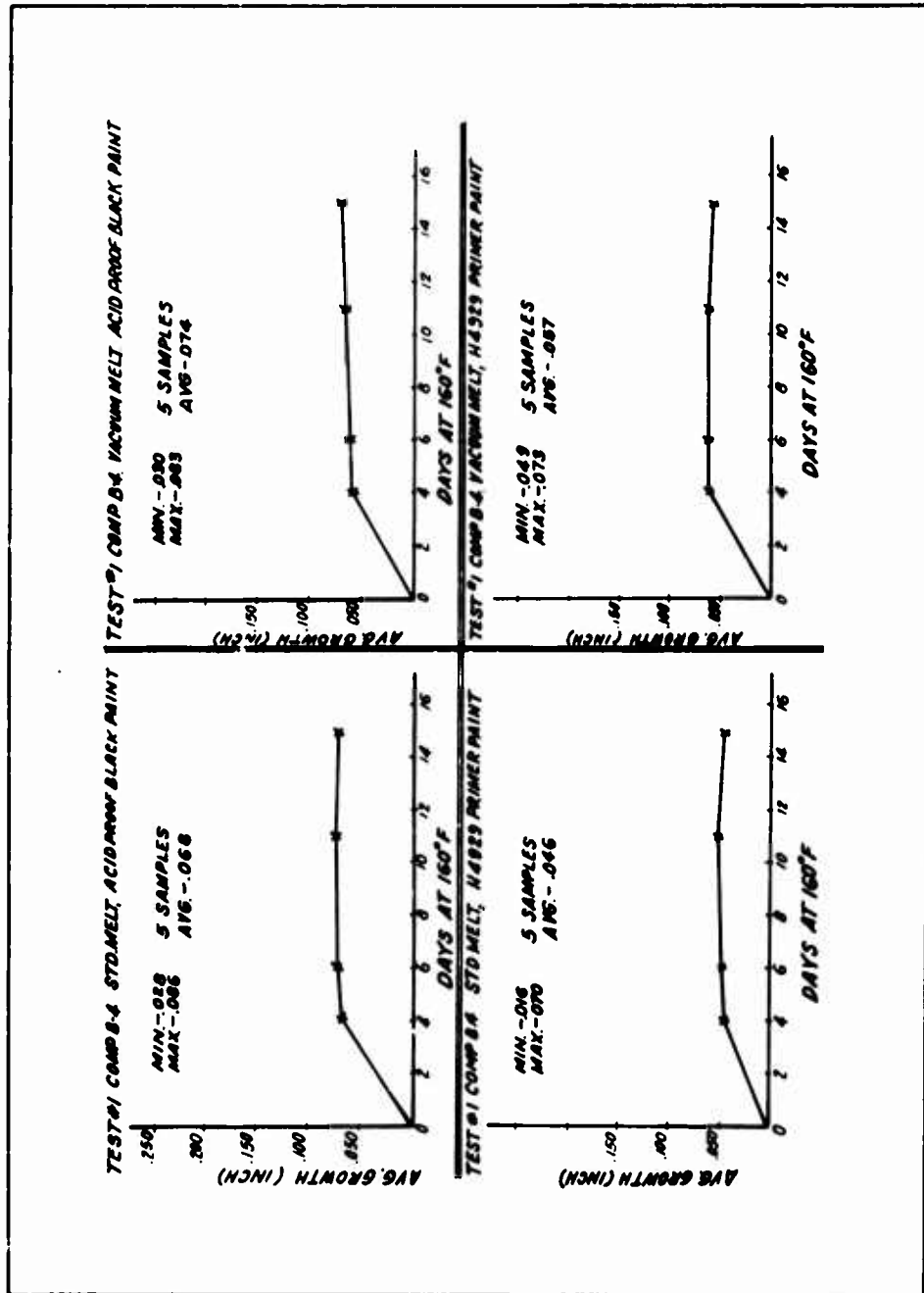


Figure 3.

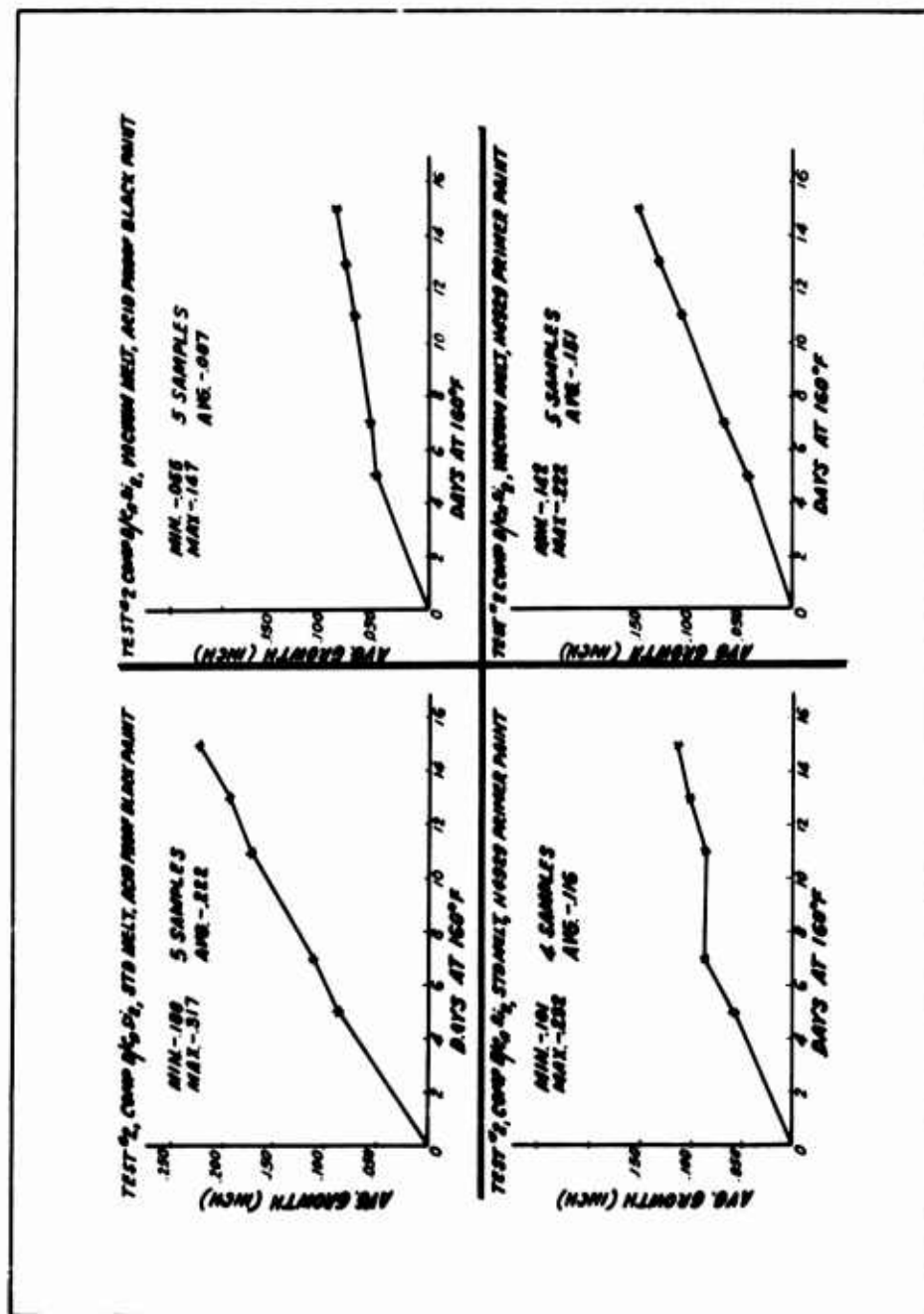


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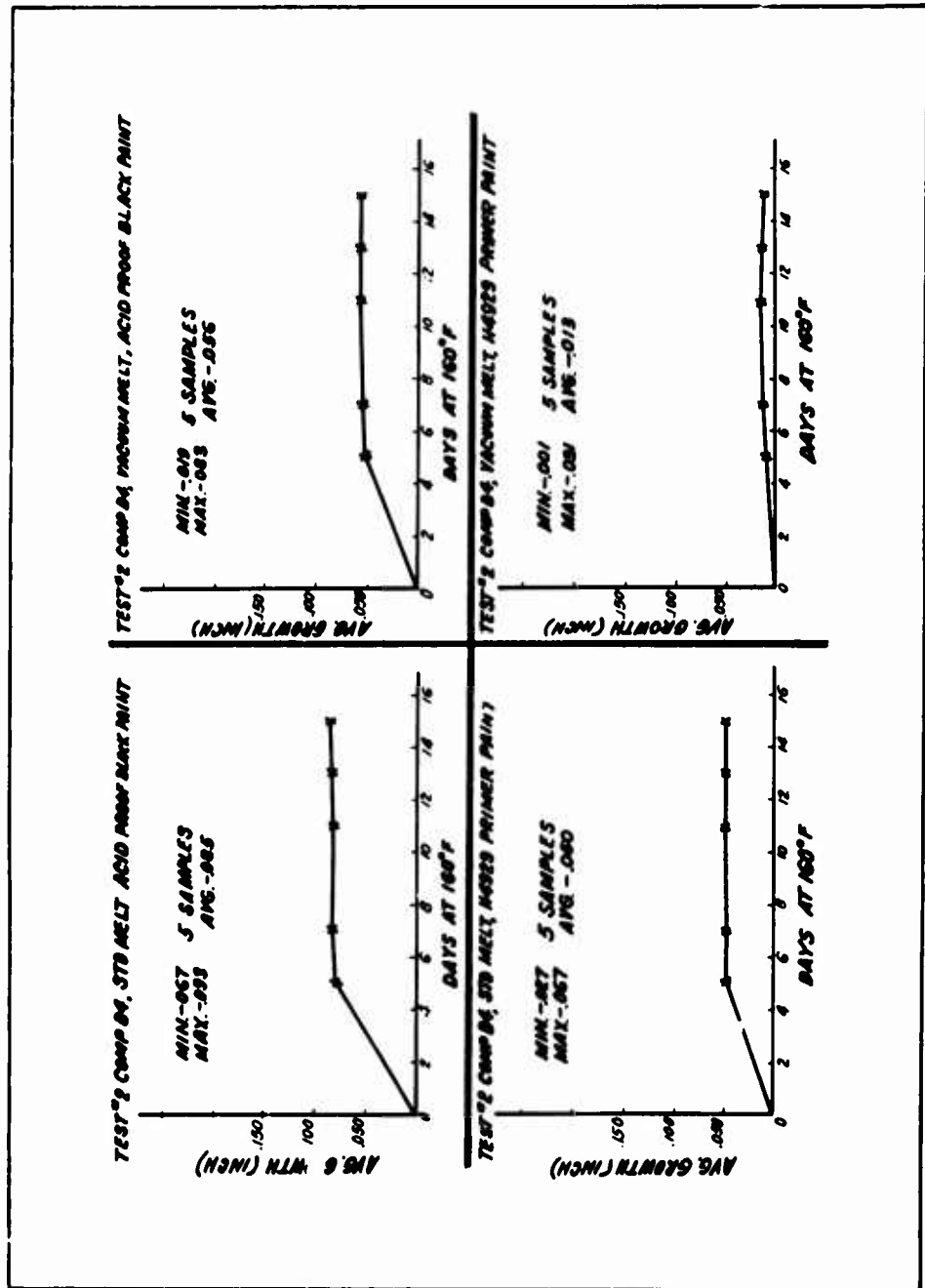


Figure 5.

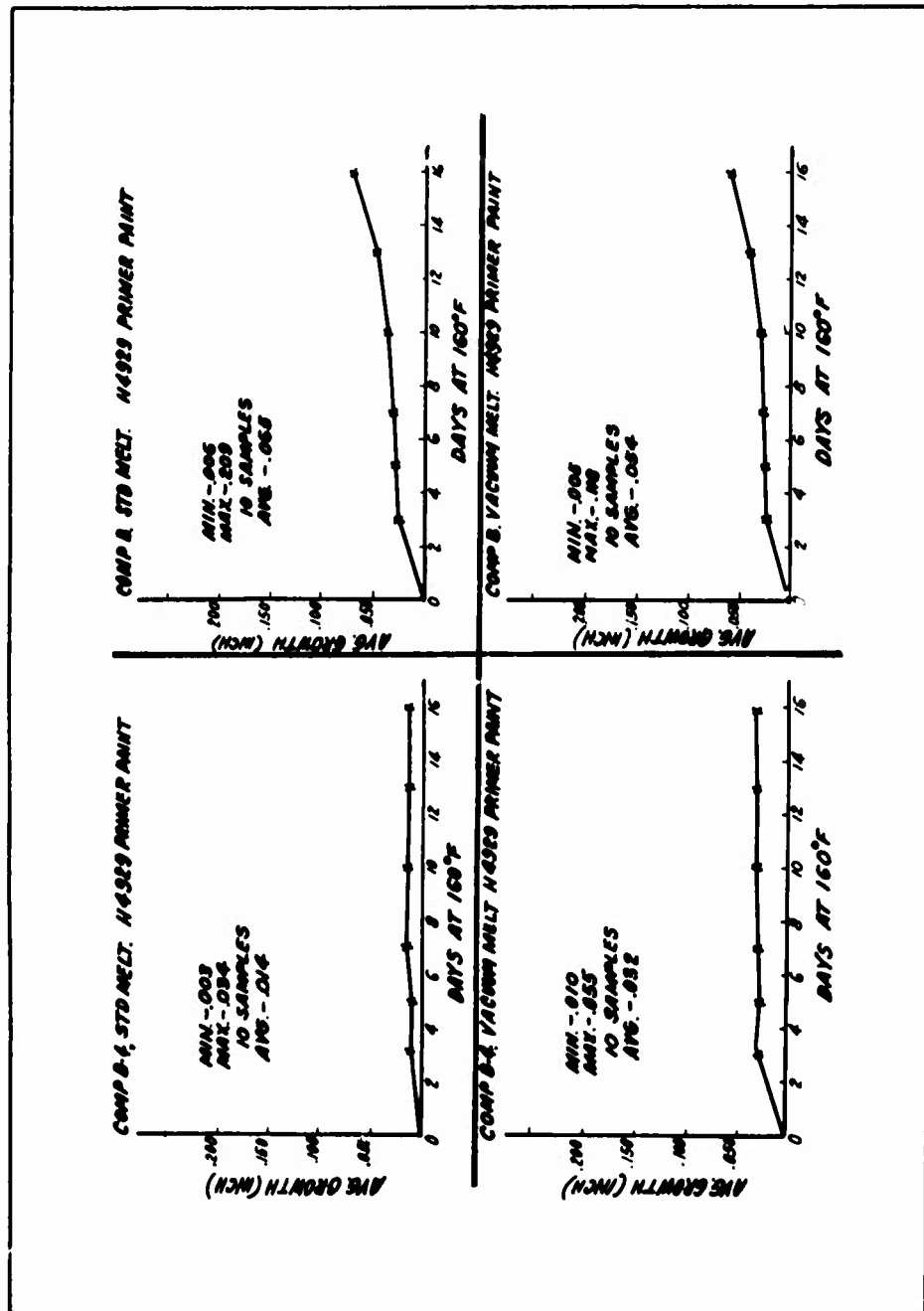
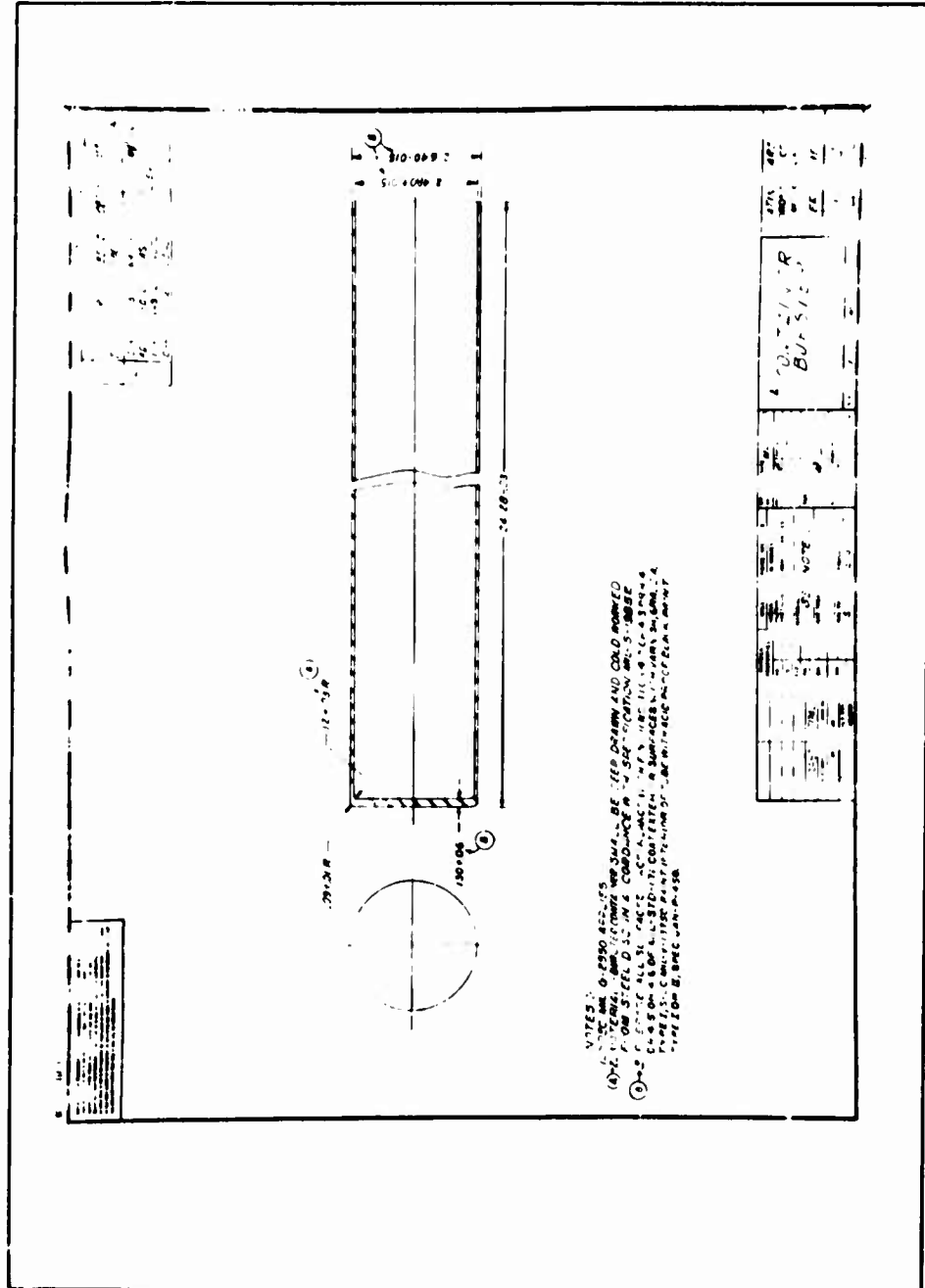


Figure 6.



ABSTRACT DATA

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18 pp, figures, tables
Unclassified memorandum from the
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The growth of Composition B-type charges was investigated because of its potential safety hazard during firing. The explosives tested were Composition B, Composition B/calcium silicate (99.5/0.5), Composition B4 and TNT. They were either standard or vacuum melted and cast in XM83 Bursters. The interior of the burster tube was coated with either acid-proof black paint or MIL-P-22332 primer paint. Then these charges were subjected to 160°F for 15 days.

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The maximum growth (0.430 inch) was observed with Composition B when standard melted and cast into acid-proof black painted coated-burster tubes and Composition B4 yielded the least growth (0.070 inch) when cast into MIL-P-92338 primer paint coated burster tubes. The addition of calcium silicate, vacuum melting the explosive and changing the interior coating to MIL-P-92338 primer paint reduced the growth considerably but did not eliminate it. Explosive growth cannot be entirely eliminated, but by loading below the top of the tube, the growth can be tolerated.

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